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ABSTRACT

Jobs requiring mathematical skills are growing at double the rate of overall employment. Standards for Two-Year College and Lower Division Mathematics (STCLDM) are being developed to guide reform in introductory college mathematics. Efforts to develop the STCLDM began at an August 1991 planning session with the Mathematical Sciences Education Board. Through subsequent funding from Exxon and the National Science Foundation, initial standards were drafted in June 1993. The initial draft of the standards includes a discussion of themes throughout the mathematics curriculum, and examines standards specific to developmental mathematics, to Associate in Applied Science degree programs, and to baccalaureate-intending programs. Among the contents of the standards are the following: (1) introductory mathematics will illustrate the power of mathematical thinking as a foundation for independent, lifelong learning; (2) the mathematics instructor will foster interactive learning through writing, reading, speaking, and collaborative activities; (3) the mathematics instructor will model the use of multiple numerical, graphical, symbolic, and verbal approaches to solve a variety of problems; (4) students will learn important mathematics knowledge through mathematical modeling applied to real world situations; and (5) as a result of application of the standards, students will be able to choose the appropriate tools and technology to solve mathematical problems and to judge the reasonableness of the results, and will be able to work effectively in groups and communicate about mathematics orally and in writing. (PAA)

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Curriculum and Pedagogical Reform for Lower-Division Mathematics: Moving Beyond Myths to Standards

1993 Annual Conference of the League for Innovation in the Community College
Reinventing the Community College, Using Information Technology
...To do things differently
...To do different things
November 14-17, Nashville, TN

Presenter: Judy Hector, Mathematics Division Chair
Walters State Community College, Morristown, TN

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A report on and discussion of Standards for Curriculum and Pedagogical Reform in Two-Year College and Lower Division Mathematics Circulating Draft, October, 1993 Published by American Mathematical Association of Two-Year Colleges with funding from the National Science Foundation and the Exxon Educational Foundation.

Why standards for mathematics at this level?

By the year 2000, the U.S. economy is expected to create more than 21 million new jobs, most of which will require both post secondary education and the use of mathematics.
--National Research Council, A Challenge of Numbers, 1990.

Less than half of all U.S. twelfth graders have mastered the mathematics covered by the seventh grade.
--National Science Foundation, Indicators of Science and Mathematics Education, 1992.

American businesses spend more than $25 billion each year on remedial education for their employees.
--The New York Times, 17 December 1989.

If you always do
what you've
always done,
you'll always get
what you've
always got!

American colleges have done well at producing an educated elite. Jobs requiring mathematical skills are growing at double the rate of overall employment. In the past, white males have filled such jobs. The year 2000 will be marked by a work force in which over 40 percent of the new entrants are minorities or women. The problem won't be too few jobs, but rather too few skilled workers for existing jobs. Even at the elite level, there are problems. The number of doctorates awarded to U.S. citizens in science, engineering, and mathematics is decreasing

The National Council of Teachers of Mathematics was the first professional organization to set voluntary standards for education. The NCTM standards are guiding reform in K-12. The Standards for Two-Year College and Lower Division Mathematics are being developed to guide reform in introductory college mathematics.

<u>A Metaphor</u>

Mathematics education as a life-long journey.
The diverse students needing introductory college mathematics are adults.
They need a broad highway to success with
multiple entrance ramps,
ease in changing lanes, and exits which allow life-long
learners to return.
These adults need to be introduced to mathematics
as a discipline.
The goals in the first two years of college are
practical, civic,
professional, and cultural.

1. To help individuals solve problems of adult life.
2. To enable citizens to participate intelligently in civic affairs.
3. To prepare adults for jobs, vocations, or professions.
4. To impart that mathematics is a dynamic, developing element of human culture.

How are these college mathematics standards being developed?

*August, 1991 Planning session with the Mathematical Sciences Education Board

*Initial funding from Exxon of $50,000 and from AMATYC

*1991-92 Steering committee formed: American Mathematical Society, Mathematical Association of America, MSEB, NCTM, National Association for Developmental Educators.

*February, 1993 Steering committee meeting

*March, 1993 NSF funding $80,000

*June, 1993 Week-long meeting of task force to draft initial standards.

*Fall, 1993 Rewriting for October draft

*April, 1994 Receive written comments and contributions. Participants will write comments in this League for Innovation session.

*June, 1994 Week-long rewriting session

*November, 1994 Final document and implementation

How is the document organized?

1. Introduction
2. The CORE: Themes throughout the Mathematics Curriculum
3. Developmental Mathematics
4. Associate in Applied Science Degree Programs
5. Baccalaureate-Intending Programs

What are some of the contents?

Goals at the CORE of Introductory College Mathematics

1. Introductory college mathematics will increase participation in mathematics and careers using mathematics for ALL students.

2. Introductory college mathematics will provide rich, deep experiences that encourage independent, nontrivial exploration in mathematics, build tenacity, and reinforce confidence in the ability to use mathematics appropriately and effectively.

3. Introductory college mathematics will present mathematics as a developing human discipline and demonstrate its connections to other disciplines.

4. Introductory college mathematics will illustrate the power of mathematical thinking as a foundation for independent, lifelong learning.

Standards for Instructional Strategies

1. The mathematics instructor will use appropriate technology, naturally, and routinely, in the teaching of mathematics.

2. The mathematics instructor will foster interactive learning through writing, reading, speaking, and collaborative activities. Learning activities should include projects and apprenticeship situations that encourage independent thinking and require sustained effort and time.

3. The mathematics instructor will actively involve students in meaningful mathematics problems which build upon their experiences, focus on broad mathematical themes, and build connections within branches of mathematics.

4. The mathematics instructor will model the use of multiple approaches-numerical, graphical, symbolic, and verbal-to solve a variety of problems.

If you always do what you've always done in pedagogy, what will you always get from problems of this sort? $(2+3)^2$ $(x+3)^2$

Mathematics faculty who use a concrete representation of multiplication such as algebra tiles are finding that students visualize $(x+3)^2$ as x^2+6x+9 and do not make the usual mistake of writing x^2+9. Likewise, students who use graphing calculators regularly can readily see that these two functions are different.

$y=(x+3)^2$ $y=x^2+9$

A change in pedagogy, use of multiple representations and technology, enhance learning.

Standards for Content Themes

1. Students will learn important mathematics knowledge through mathematical modeling applied to real world situations.

2. Students will engage in problem solving both in the context of applied situations and in extending knowledge of mathematical theory.

3. Students will extend logical reasoning skills in activities which ask them to make and test conjectures, formulate counter examples, follow logical arguments, judge the validity of arguments, and construct valid arguments.

Standards for Student Outcomes

1. Students will possess the mathematical tools to recognize, analyze and solve problems using numerical, graphical, and symbolic approaches to create mathematical models of real-life situations.

2. Students will have the confidence to access and use needed mathematics and other technical information independently, to form conjectures from an array of specific examples, and to draw logical conclusions from general principles.

3. Students will be able to choose the appropriate tools and technology to solve mathematical problems and judge the reasonableness of the results.

4. Students will be able to work effectively in groups and communicate about mathematics both orally and in writing.

Audience reactions to a portion of the standards were solicited at the League of Innovation Conference with the following materials:

Your reactions are needed. Please write out comments on the sheet of paper your are given. General comments are welcome. More specifically, how do you feel about engaging in the instructional strategies presented here?

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